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bart impact program

ENVIRONMENT PROJECT PRELIMINARY FINDINGS REGIONAL AIR EMISSIONS

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The BART Impact Program is a comprehensive, policy-oriented study and evaluation of the impacts of the San Francisco Bay Area's new rapid transit system (BART).

The program is being conducted by the Metropolitan Transportation Commission, a nine-county regional agency established by state law in 1970.

The program is financed by the U. S. Department of Transportation, the U. S. Department of Housing and Urban Development, the National Science Foundation, and the California Department of Transportation. Management of the Federally-funded portion of the program is vested in the U. S. Department of Transportation.

The BART Impact Program covers the entire range of potential rapid transit impacts, including impacts on traffic flow, travel behavior, land use and urban development, the environment, the regional economy, social institutions and life styles, and public policy. The incidence of these impacts on population groups, local areas, and economic sectors will be measured and analyzed. The benefits of BART, and their distribution, will be weighed against the negative impacts and costs of the system in an objective evaluation of the contribution that the rapid transit investment makes toward meeting the needs and objectives of this metropolitan area and all of its people.

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ENVIRONMENT PROJECT
PRELIMINARY FINDINGS
REGIONAL AIR EMISSIONS

MARCH 1975
TECHNICAL MEMORANDUM

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PRELIMINARY FINDINGS
REGIONAL AIR EMISSIONS

THE ENVIRONMENT PROJECT

BART IMPACT PROGRAM

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This study presents findings relative to changes in the emission of automobile generated pollutants (CO, HC and NO_x) resulting from VMT changes associated with the use of BART. The effect of changing VMT on emissions of pollutants is assessed for both the total 9-county Bay Area airshed and for the 3-county BART service area. The findings are related to the Control Strategy Plan for the San Francisco Bay Area.

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PRELIMINARY FINDINGS

REGIONAL AIR EMISSIONS

Introduction

One of the possible consequences of a rapid transit system such as BART is to divert people from using their personal cars to using transit and thus reduce the number of vehicle miles traveled (VMT) by automobiles. As a result, a decrease in automobile generated pollutants (carbon monoxide, hydrocarbons and oxides of nitrogen) occurs, along with an improvement in air quality. While there are methods for evaluating the impact of decreasing VMT on air quality (DIFKIN and SAl models), unfortunately there is presently no simple and inexpensive method. However, a Vehicle Emissions Model (VEM) has been developed which is capable of assessing the effect of decreasing vehicle miles traveled on the emissions of pollutants. This report describes the results of applying this model to the BART situation in the San Francisco Bay Area.

Study Methodology

Air pollutant emissions from motor vehicles emanate from three principle sources: exhaust, crankcase blowby and evaporation from the fuel tank and carburetor. All oxides of nitrogen (NO_x) and carbon monoxide (CO) emissions come from the exhaust pipe, while approximately 55% of the hydrocarbons (HC) come from engine exhaust, 25% from the blowby and 20% from evaporation.[1]

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[1] "Compilation of Air Pollution Emission Factors," Environmental Protection Agency, Publication #AP-42, 1972.

All light duty vehicles were assumed to be gasoline powered. Calculations were made on a county basis and freeway and surface street (VMT) were considered separately, due to the input requirements of the VEM (specifically the model year distribution and vehicle average speeds). The baseline year chosen was 1972 because of availability of data. Even though BART was not in passenger operation during the year, it was assumed that presently induced VMT reductions would have occured in 1972 had BART been in operation. The average speeds used in this analysis were 53 MPH for freeways and 26 MPH for surface streets (national averages, before 55 MPH speed limit).

The initial step in the analysis was to calculate baseline year emissions without VMT reductions induced by BART. This was derived from the VEM, where the output is emission factors (in grams/mile) for HC, NO_x, and CO. To calculate the total quantity of vehicle emissions, the emission factor was multiplied by the total VMT. Then, to arrive at reduction in emissions induced by BART, the amount of reduction in vehicle miles traveled was established. In view of the fact actual VMT reduction figures have not been developed as of this time, for this analysis a 3% VMT reduction (figure obtained from the Metropolitan Transportation Commission (see Appendix) in Alameda, Contra Costa and San Francisco counties (the only counties served by BART) was assumed. The final step in the process was to mathematically relate the VMT reduction to emission reduction.

Study Results

The results of this analysis are presented in Table 1. The three counties in which BART is located (Alameda, Contra Costa and San Francisco) are presented first. Within these three counties the reductions are approximately 3.0% of the emissions of hydrocarbons, carbon monoxide and oxides of nitrogen.

Hydrocarbons - 2.99%

Carbon Monoxide - 2.98%

Oxides of Nitrogen - 2.83%

TABLE 1

REGIONAL EMISSIONS REDUCTIONS DUE TO BART

			Emissions from Freeway VMT (tons/day)			Emissions from Surface Street VMT (tons/day)			Emission Reductions from Freeway VMT (tons/day)			Emission Reductions from Surface Street VMT (tons/day)		
County	Freeway VMT (10^3 mi)	Surface Street VMT (10^3 mi)	HC	CO	NO_x	HC	CO	NO_x	HC	CO	NO_x	HC	CO	NO_x
Alameda	7006	5850	40.6	235.4	44.1	46	320	28	1.2	7.1	1.3	1.4	9.6	0.8
Contra Costa	3334	2662	19.4	112.5	20.9	21	146.3	12.7	0.6	3.4	0.6	0.6	4.4	0.4
San Francisco	3510	2791	19.3	112.9	22.1	20.8	146.1	13.4	0.6	3.4	0.7	0.6	4.4	0.4
Sub Total	13850	11303	79.3	460.8	87.1	88.1	612.4	54.1	2.4	13.9	2.6	2.6	18.4	1.6
Marin	1618	720	9.2	53.6	10.3	5.5	38.8	3.5						
Napa	30	732	0.2	1	0.2	5.9	41	3.5						
San Mateo	4403	2863	24.5	142.4	27.6	21.6	150.8	13.6						
Santa Clara	4946	6944	28.7	166.1	31.1	54.6	379.6	33.1						
Solano	694	627	4	23.4	4.4	4.9	34.4	3						
Sonoma	589	1494	3.6	20.7	3.7	12.4	85.5	7						
Sub Total	12280	13380	70.2	407.2	77.3	104.9	730.1	63.7						
Totals	26,130	24,683	149.5	868.0	164.4	193.0	1342.5	117.8	2.4	13.9	2.6	2.6	18.4	1.6

If reductions are viewed in terms of the entire Bay Area airshed as defined by EPA (9 counties) the influence of BART-induced emission reductions is even smaller, amounting to less than 1.5% of the region-wide emissions.

Hydrocarbons	1.46%
Carbon Monoxide	1.46%
Oxides of Nitrogen	1.48%

These reductions can be related to EPA's required emissions reductions as called for in the Control Strategy for the San Francisco Bay Area:[4]

EPA Required Reductions (from all sources)	BART-Induced Reductions
HC - 442 tons/day	HC - 5 tons/day
CO - 1209 tons/day	CO - 32 tons/day
NO_x - None required	NO_x - 4 tons/day

Clearly the effects of BART in helping to achieve EPA's standard are negligible. Even if BART patronage were to increase two to three times its present level, with corresponding changes in vehicle miles traveled, its effect on reducing polluting emissions region-wide would not be significant, and the effect on any single county would at best be marginal. It would appear that rail transit systems by themselves cannot (nor are they expected to) provide much relief in reducing regional emission levels in major metropolitan areas. Other studies have confirmed the finding that, in general, rail rapid transit systems do not reduce VMT sufficiently to affect emissions.[4,5] Estimates of emissions reduction for the

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[4] "Air Quality Implementation Plan Development for Critical California Regions: San Francisco Bay Area Intrastate AQCR," prepared by TRW, Inc. for EPA, June, 1973.

[5] "Transportation Control Strategy Development for the Metropolitan Los Angeles Region," prepared by TRW, Inc. for EPA, January, 1973.

proposed Atlanta Regional Transit System indicate an 8% reduction in total emitted pollutants when the system goes into operation.[6] However, this is based on a projected 8% reduction in vehicle miles traveled (as compared with an estimated 3% for the BART system).

There might, however, be more significant effects of a transit system on local air quality since these systems may tend to reduce local congestion (such as the San Francisco-Oakland Bay Bridge) and thus local air pollution. This, of course, must be balanced against possible increased congestion around station areas. The effects on local air quality will be the subject of later impact analyses.

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[6] "Metropolitan Atlanta Rapid Transit System - Final Environmental Statement" prepared by Urban Mass Transit Administration, U.S. Department of Transportation, March, 1973.

APPENDIX

Computational Basis for Estimation of BART-Induced Reductions in Regional VMT

APPENDIX

Computational Basis for Estimation of BART-Induced Reductions in Regional VMT

MTC provided the estimates of BART-induced VMT reduction used in the associated estimates of regional emissions reductions. The basis for the VMT computations follows.

I. Regional VMT

Regional VMT data came from MTC model projections (1965-1970-1980-1990). 1970 VMT, including trucks, was projected at 63,679,000. A straight-line interpolation gives 53,862,000 for 1972, the year covered by the analysis in this report.

Since no truck trips were hypothesized as being displaced by BART (though possibly redistributed over the day), a "truck correction factor" developed by CALTRANS was used, assuming that trucks represent approximately 6% of VMT. CALTRANS used the factor 0.9434. Thus, 53,862,000 x 0.9434 = 50,813,000 is the figure used for VMT by light-duty vehicles in 1972.

MTC projections for distribution of VMT among the nine counties and by freeway or non-freeway were available for 1970. It was assumed that the proportionate shares would not be much different for 1972. County-share proportions were first applied to the 50,813,000 figure. Then the freeway/non-freeway shares were applied, specific to each county, since there are substantial differences among counties. The factors were:

		% of County VMT on	
County	Share of VMT	freeway	non-freeway
Ala.	25.3	54.5	45.5
C.C.	11.8	55.6	44.4
Marin	4.6	69.2	30.8
Napa	1.5	4.0	96.0
S.Fran.	12.4	55.7	44.3
S.Mateo	14.3	60.6	39.4
S.Clara	23.4	41.6	58.4
Solano	2.6	52.5	47.5
Sonoma	4.1	28.3	71.7
Total	100.0	51.4	48.6

The figures in Table 1 of this report are based on the above.

II. Computation of VMT-equivalent for BART Patronage

This computation started with BART's 1975 "full-service" station-to-station projections from their 1971 "Interstation Fare Schedule" report. Each cell of the 33 x 32 triangular matrix was multiplied by the station-to-station distance in miles (to the nearest tenth-mile). This person-mile table was then aggregated to the county level, as shown in Table A1. From the BART Passenger Profile Surveys I & II, access mode figures by county of BART trip origin were derived:

	County			
	Ala.	C.C.	S.F.	S.M. (Daly City)
Drove alone	33.2%	39.6%	16.6%	30.2%
Pooled	9.1	12.2	4.5	15.6

From the Bay Bridge and Caldecott Tunnel auto occupancy data amassed by ITTE over several years, persons per auto for car pools were derived. A straight 2.5 persons per auto factor for car-pooling was used. The table below shows the results of applying this latter factor, along with the above mode-of-access factors to the numbers in Table A1.

VMT Equivalent for Full-BART Patronage

D = number of one-occupant vehicles which were diverted to BART

P = number of car-pool vehicles diverted to BART

Origin county	Destination county		
	Ala	C.C	S.F.
Ala	D-107,100	X	D-295,400
	P- 11,700		P- 32,400
C.C.	D- 96,200	D- 1,500	D-216,800
	P- 11,800	P- 200	P- 26,700
S.F.	X	X	D- 23,800
			P- 2,600
S.M.	D- 5,100	D- 500	D- 23,900
	P- 1,100	P- 100	P- 4,900

(NOTE: Directionality is assumed to be the primary commute direction, since no other assumption could be reasonably made from existing data. Thus, it is assumed no one commutes to San Mateo Co. (Daly City) on BART, and that there is no reverse commute from S.F.)

TABLE A1

BART FULL-SERVICE PERSON-TRIP-MILES (1975)

Origin County	Destination County	Alameda	Contra Costa	San Francisco
Alameda		322,565	X	889,661
Contra Costa		242,917	3,783	547,446
San Francisco		X	X	143,692
San Mateo (Daly City)		16,950	1,755	79,288
			TOTAL	2,248,057

"X" indicates assumption that no reverse commute trips occur between the counties shown.

The grand total of this table is 861,800 VMT. This is the estimated average weekday daily volume for full-service BART.

III. Computing the BART-induced VMT Reduction

A number of assumptions were implicit here. It was assumed that:

(1) Travelling by BART does not increase the total trip length for motorists, i.e., the trip length to and from the BART station is precisely equal to trip length to and from the hypothetical "auto trunkline" which was used before BART.

(2) BART can only remove vehicles from streets and highways in counties where it operates.

(3) Those vehicles, once removed, no longer contribute to regional VMT at all.

(4) 1972 BART-equivalent VMT would be equal to the expected 1975 VMT-equivalent (i.e., no change in trip making patterns 1972-75).

(5) No adjustment should be made to VMT to subtract that fraction of regional VMT which could not possibly be served directly by BART (e.g., work trips to the San Jose-Palo Alto area, work trips to the Contra Costa refineries, etc.) even though trip origins may be in BART's "service area".

In summary, the total 1972 VMT for the three BART counties is 25,153,000 (assuming no BART service available). Thus, the percent VMT reduction if BART had been there in 1972 running at its full-service level is 861,800/25,153,000 = 3.4%.